1. Demographic Information

Background:

The Ohio Transfer Module (OTM), Subgroup 2, Mathematics, Statistics, and Logic have been tasked with exploring the possibility of a sequence of Life Science Calculus courses. The proposed two-semester sequence (TMM024 & TMM025) is intended for students majoring in the biological or environmental sciences and/or preparing for admission to medical, pharmaceutical, dental, veterinary or other life-science-related professional schools. These courses are adapted from the MAA/CUPM 2015 curriculum guide.

The proposed Life Science Calculus I (TMM025) learning outcomes are based on college level mathematics. TMM024 serves the following purpose:

· Serve as a pre-requisite for Life Science Calculus II (TMM025)
· Act as a course integrating limits, derivatives, and integrals to describe and gain insight into biological processes and populations.
· Act as a course modeling concepts from the life sciences that include: Algebraic, logarithmic, and exponential.

Life Science Calculus II (TMM025) learning outcomes are also based on college level mathematics. TMM025 serves the following purpose:

· Act as a course integrating limits, derivatives, integrals and differential equations to describe and gain insight into biological processes and populations.
· Act as a course modeling concepts from the life sciences that include: Algebraic, logarithmic, exponential, and trigonometric functions.

What we need from you:
Subgroup 2 seeks endorsement of the proposed learning outcomes for TMM024 & TMM25. Please review the proposed learning outcomes and coordinate efforts within your institution to complete the endorsement survey to determine if your institution agrees or disagrees with the proposed course learning outcomes. We are collecting only one response per institution.

Please provide your institutional response by **November 30, 2020**.

Thank you in advance for your assistance. If you have any questions, please contact the faculty lead for the Ohio Transfer Module Mathematics, Statistics, and Logic Review Panel/Subgroup 2, Dr. Ricardo Moena at ricardo.moena@uc.edu or (513) 556-4055 or Jessi Spencer, Director of Articulation and Transfer Policy, Budget, and Constituent Relations at jspencer@highered.ohio.gov or (614) 728-4706.

* 1. Demographic Information about the Person Completing this Survey

Name	
Institution	
Department	
Title	
Email	
Phone	

* 2. Please Indicate the Type of Institution that you represent

- ◯ Two-Year Institution
- ◯ Four-Year Institution

2. Life Science Calculus I (TMM024)

Typical Range: 3-4 Semester Hours

This is the first course in a two-semester sequence of calculus courses intended for students majoring in the biological or environmental sciences and/or preparing for admission to medical, pharmaceutical, dental, veterinary or other life-science-related professional schools. Students in this sequence must reason with limits, derivatives, integrals and differential equations to describe and gain insight into biological processes and populations. Algebraic, logarithmic, exponential, and trigonometric functions are all used to model concepts from the life sciences.

To qualify for TMM024 (Life Science Calculus I - LSCI), a course must achieve all of the following essential learning outcomes listed in this document (marked with an asterisk). These make up the bulk of a Life Sciences Calculus I course. Courses that contain only the essential learning outcomes are acceptable from the TMM024 review and approval standpoint. It is up to individual institutions to determine further adaptation of additional course learning outcomes of their choice to support their students' needs. In addition, individual institutions will determine their own level of student engagement and manner of implementation. These guidelines simply seek to foster thinking in this direction. Sample tasks are listed to help clarify the intention of the essential learning outcomes, but no specific sample task is required for approval.

1. Below are the learning outcomes for TMM024- Life Science Calculus I listed individually. Do you agree with these outcomes?

	Yes- should be essential	Yes- should be non-essential	No
Review of Elementary Functions 1.1. Construct a linear model from given linear data. Interpret the slope of a linear model as a constant rate of change. Recognize a situation with constant rate of change as appropriate for a linear model.* (Essential)	◯	◯	◯

	Yes- should be essential	Yes- should be non-essential	No
Review of Elementary Functions 1.2. Use exponential functions to model growth and decay with constant percentage change. Compute the half-life or doubling time of an exponentially-modelled quantity. Examples include population growth and drug concentration. * (Essential)	○	○	○
Review of Elementary Functions 1.3. Use logistic functions to model natural phenomena such as bounded population growth. Identify the horizontal asymptotes and point of steepest increase/decrease. * (Essential)	○	○	○
Review of Elementary Functions 1.4. Interpret and generate logarithmic scale graphs. Use logarithmic scale graphs to distinguish different types of growth. * (Essential)	○	○	○
Limits and Continuity 2.1. Evaluate limits using tables of function values. This includes one- and two-sided limits at a point as well as limits at infinity and infinite limits. * (Essential)	○	○	○

	Yes- should be essential	Yes- should be non-essential	No
<u>Limits and Continuity</u> 2.2. Evaluate limits using a graph of a function. This includes one- and two-sided limits at a point as well as limits at infinity and infinite limits. * (Essential)	○	○	○
<u>Limits and Continuity</u> 2.3. Use the limit to describe graphical attributes of a function and interpret the meaning of these attributes in a given life science context. * (Essential)	○	○	○
<u>Limits and Continuity</u> 2.4. Evaluate limits algebraically using limit laws. * (Essential)	○	○	○
<u>Limits and Continuity</u> 2.5. Determine continuity of a simple function from its graph. * (Essential)	○	○	○
<u>Limits and Continuity</u> 2.6. Use the definition of continuity to determine whether a given function is continuous. * (Essential)	○	○	○
<u>Rate of Change</u> 3.1. Interpret the slope of a secant line as an average rate of change of a quantity using correct units. * (Essential)	○	○	○

	Yes- should be essential	Yes- should be non-essential	No
Rate of Change 3.2. Relate average rate of change over an interval to instantaneous rate of change at a point. Decide if a given graph shows a tangent line or a secant line. * (Essential)	○	○	○
Rate of Change 3.3. Estimate instantaneous rate of change from a graph using a tangent line. * (Essential)	○	○	○
Rate of Change 3.4. Interpret the slope of a tangent line as instantaneous rate of change of a quantity, using correct units. * (Essential)	○	○	○
Differentiation 4.1. Find the derivative of a function using the limit definition of derivative. This computation can be performed numerically (with tables) and algebraically. * (Essential)	○	○	○
Differentiation 4.2. Compute derivatives of elementary algebraic and transcendental functions using the power rule, product rule, quotient rule, and chain rule. * (Essential)	○	○	○
Differentiation 4.3. Interpret the value of a derivative as a rate of change with units. * (Essential)	○	○	○

	Yes- should be essential	Yes- should be non-essential	No
Differentiation 4.4. Determine where a derivative does not exist, using a function's formula or its graph. * (Essential)	◯	◯	◯
Differentiation 4.5. Compute higher-order derivatives e.g. second derivatives. * (Essential)	◯	◯	◯
Applications of Derivatives 5.1. Use the first and second derivative of a function to gather information about the function, including: intervals of increase/decrease, critical points, relative and absolute extrema, concavity, and inflection points. * (Essential)	◯	◯	◯
Applications of Derivatives 5.2. Solve optimization problems in the life science context using first and second derivatives. * (Essential)	◯	◯	◯
Integration 6.1. Use Riemann sums to estimate definite integrals. * (Essential)	◯	◯	◯
Integration 6.2. Evaluate definite integrals using the Fundamental Theorem of Calculus. * (Essential)	◯	◯	◯

	Yes- should be essential	Yes- should be non-essential	No
Integration 6.3. Evaluate indefinite integrals using basic antiderivative formulas e.g. power rule. * (Essential)	○	○	○
Integration 6.4. Answer questions motivated by the life sciences by computing areas under graphs. * (Essential)	○	○	○
Integration 6.5. Interpret the meaning of a definite integral of a function in terms of areas of regions between the graph of the function and the x-axis. * (Essential)	○	○	○
Integration 6.6. Find indefinite and definite integrals using the method of substitution. * (Essential)	○	○	○

2. Comments:

3. Life Science Calculus II (TMM025)

Typical Range: 3-4 Semester Hours

This is the second course in a two-semester sequence of calculus courses intended for students majoring in the biological or environmental sciences and/or preparing for admission to medical, pharmaceutical, dental, veterinary or other life-science-related professional schools. Students in this sequence must reason with limits, derivatives, integrals and differential equations to describe and gain insight into biological processes and populations. Algebraic, logarithmic, exponential, and trigonometric functions are all used to model concepts from the life sciences.

To qualify for TMM025 (Life Science Calculus II - LSCII), a course must achieve all of the following essential learning outcomes listed in this document (marked with an asterisk). These make up the bulk of a Life Sciences Calculus II course. Courses that contain only the essential learning outcomes are acceptable from the TMM025 review and approval standpoint. It is up to individual institutions to determine further adaptation of additional course learning outcomes of their choice to support their students' needs. In addition, individual institutions will determine their own level of student engagement and manner of implementation. These guidelines simply seek to foster thinking in this direction. Sample tasks are listed to help clarify the intention of the essential learning outcomes, but no specific sample task is required for approval.

1. Below are the learning outcomes for TMM025- Life Science Calculus II listed individually. Do you agree with these outcomes?

	Yes- should be essential	Yes- should be non-essential	No
Trigonometric Functions 1.1. Explain the structure of the graphs of f(x)=sin(x), g(x)=cos(x) (amplitude, period, horizontal and vertical intercepts) using the unit circle definition of the functions. * (Essential)	○	○	○
Trigonometric Functions 1.2. Explain the role of the parameters A,B,C and D in the expressions f(x)=A sin(Bx+C)+D and g(x)=A cos(Bx+C)+D. * (Essential)	○	○	○

	Yes- should be essential	Yes- should be non-essential	No
<u>Trigonometric Functions</u> 1.3. Recognize periodic phenomena and recognize that such phenomena can be modeled by functions of the form f(x)=A1 cos(B1 x+C1)+ A2 sin(B2 x+C2). * (Essential)	○	○	○
<u>Trigonometric Functions</u> 1.4. Use technology to model given periodic data by finding values of the parameters in the expression * (Essential)	○	○	○
<u>Trigonometric Functions</u> 1.5. Apply the basic concepts and rules of derivatives to functions involving trigonometric expressions. * (Essential)	○	○	○
<u>Trigonometric Functions</u> 1.6. Apply the concepts of integral calculus to functions involving trigonometric expressions. * (Essential)	○	○	○
<u>Applications of Definite Integrals</u> 2.1. Calculate area of bounded regions. * (Essential)	○	○	○
<u>Applications of Definite Integrals</u> 2.2. Interpret a definite integral as an accumulation of change and apply this understanding to the life science calculus setting. * (Essential)	○	○	○

	Yes- should be essential	Yes- should be non-essential	No
Integration Techniques 3.1. Find indefinite and definite integrals using the method of integration by parts. * (Essential)	○	○	○
Integration Techniques 3.2. Find indefinite and definite integrals using the method of partial fraction decomposition. * (Essential)	○	○	○
Differential Equations Solve separable differential equations by analytical methods. * (Essential)	○	○	○
Differential Equations 4.2. Understand the relationship between slope fields and solution curves of first-order differential equations. * (Essential)	○	○	○
Differential Equations 4.3. Use a differential equation to interpret a physical situation in which a quantity and its rate of change are dependent on one another and apply this understanding to various life science problems. *	○	○	○
Differential Equations 4.4. Perform a qualitative analysis of an autonomous differential equation, without computing analytical solutions. *	○	○	○

2. Additional Comments:

4. Survey Completion

Thank you for completing this survey!